CLAIMS

1. A measuring device, comprising:

(a) an ultrasonic acoustic transceiver unit capable of sending and receiving acoustic signals into the body of a patient;

(b) frequency modulating circuitry which drives said transceiver unit with a signal whose frequency varies with time; and

(c) processing circuitry which extracts an indication of a distance, from at least one signal detected by said transceiver unit, said signal being a reflection of a transmission of said transceiver unit driven by said time varying frequency signal.

2. A device according to claim 1, wherein said signal is a sweeping frequency.

3. A device according to claim 2, wherein said sweeping is non-spatial.

4. A device according to claim 1, wherein said indication comprises an indication of a distance between a near wall and a far wall of a bladder.

5. A device according to claim 4, wherein said processing circuitry estimates a fill level of said bladder from said indication.

6. A device according to claim 5, comprising a memory having stored therein at least one calibration value used by said processing circuitry.

7. A device according to claim 6, including at least one user input control.

8. A device according to claim 7, wherein at least one of said at least one user input generates an indication that a bladder is full.

9. A device according to claim 7, wherein at least one of said at least one user input generates an indication that a bladder is just emptied.

10. A device according to claim 7, wherein at least one of said at least one user input is operative to receive a volume indication.

11. A device according to claim 1, wherein said processing circuitry is operative to automatically detect a maximum fill level condition by tracking fill level over time.

12. A device according to claim 5, wherein said processing circuitry is operative to estimate a residual fill volume.

13. A device according to claim 1, wherein said indication of a distance comprises a bladder wall thickness.

14. A device according to claim 5, wherein said processing circuitry is operative to estimate at least a bladder fill rate based on said indication.

15. A device according to claim 1, wherein said time varying frequency comprises a saw-tooth linear sweep.

16. A device according to claim 1, wherein said transceiver unit comprises a single ultrasonic element.

17. A device according to claim 1, wherein said transceiver unit generates a converging beam focused at a distance between 30 and 50 mm.

18. A device according to claim 1, wherein said transceiver unit generates a converging beam focused at a distance between 50 and 90 mm.

19. A device according to claim 1, wherein said transceiver unit generates a beam having a Fresnel zone covering a range of possible values for said distance.

20. A device according to claim 19, wherein said range is between 20 and 200 mm.

21. A device according to claim 1, wherein said transceiver unit comprises at least one transmitter and at least one separate receiver.

22. A device according to claim 1, wherein said transceiver unit comprises at least two transmitters and wherein said processing circuitry selects between the signal received from the two transmitters, for extracting said indication.

23. A device according to claim 22, wherein said two transmitters comprises at least three transmitters arranged two in a line and one off of the line, and each configured to aim a beam in a same general direction, but not parallel to each other.

24. A device according to claim 22, wherein said two transmitters transmit ultrasonic beams that are not parallel to each other.

25. A device according to claim 1, wherein said unit is mounted on a concave surface.

26. A device according to claim 1, comprising a strap of a length suitable for placing around a trunk of a human for mounting said unit adjacent a urinary bladder.

27. A device according to claim 1, comprising an adhesively removable gel pad adapted for coupling said transducer unit to human skin.

28. A device according to claim 1, comprising a memory storing a history of extracted indications.

29. A device according to claim 28, comprising a transmitter for transmission of data from said memory.

30. A device according to claim 28, wherein said memory serves as a urination diary memory.

31. A device according to claim 1, comprising an alert generator which generates an alert based on said indication.

32. A device according to claim 31, wherein said alert is tactile.

33. A device according to claim 1, wherein said acoustic transceiver unit transmits signals at between 200 KHz and 2000 KHz.

34. A device according to claim 1, wherein said time varying frequency varies from a minimum frequency to a maximum frequency over a time period greater than a travel time of signals at said frequency from a near wall to a far wall of a distended adult bladder.

35. A device according to claim 34, wherein said time period is at least 10 times the travel time.

36. A device according to claim 34, wherein said time period is at least 20 times the travel time.

37. A device according to claim 1, wherein said processing circuitry is adapted for processing only frequencies lower than 200 KHz.

38. A device according to claim 1, wherein said processing circuitry is adapted for processing only frequencies lower than 150 KHz.

39. A device according to claim 1, wherein said transceiver comprises a piezoelectric material excited with less than 13V.

40. A device according to claim 1, wherein said transceiver comprises a piezoelectric material excited with less than 5V.

41. A device according to claim 1, wherein said transceiver comprises at least one transducer which acts as both a transmitter and a receiver and which heterodynes a received signal with a transmitted signal.

42. A device according to claim 1, comprising a frequency filter which drops frequencies corresponding to distances not of interest.

43. A device according to claim 1, wherein said processing circuitry accumulate the contribution of at least 1 millisecond of received signals for said extracting.

44. A method of measuring a parameter of a bladder, comprising:

(a) transmitting a time-varying frequency modulated ultrasonic signal at a bladder;

(b) receiving a reflection of said signal from at least a portion of said bladder; and

(c) extracting at least an indication of a distance from a frequency of said reflection.

45. A method according to claim 44, wherein transmitting a time-varying signal comprises transmitting a plurality of time-varying signals from spatially separated transducers.

46. A method according to claim 45, comprising selecting a best reflection.

47. A method according to claim 44, wherein said indication comprises a distance to a far wall of said bladder.

48. A method according to claim 44, wherein said indication comprises a wall thickness.

49. A method according to claim 44, wherein said indication comprises a distance between a near wall and a far wall of said bladder.

50. A method according to claim 49, comprising converting said indication into an estimation of a fill level of said bladder.

51. A method according to claim 50, wherein said fill level comprises a fill volume.

52. A method according to claim 50, comprising generating an alert to a user responsive to said fill level.

53. A method according to claim 50, comprising calibrating said indication to a fill level.

54. A method according to claim 53, wherein calibrating comprises receiving a filling indicator from a user.

55. A method according to claim 54, comprising measuring an output of urine in a measuring device outside the body.

56. A method according to claim 55, wherein said device generates an electronic signal reflecting a urine volume.

57. A method according to claim 53, wherein calibrating comprises automatically tracking filling and emptying behavior of said bladder.

58. A method according to claim 44, wherein said indication comprises a thickness of a bladder wall.

59. A method according to claim 58, comprising extracting an indication of bladder slow waves in said bladder.

60. A method according to claim 44, comprising extracting a bladder fill rate from said indication.

61. A method according to claim 44, comprising extracting a urination rate from said indication.

62. A method according to claim 44, comprising extracting a residual urine volume from said indication.

63. A method according to claim 44, comprising tracking and storing said indication over time.

64. A method of calibrating a bladder urine fill detector device, comprising:

(a) measuring a volume of urine from a urination event;

(b) measuring a physical parameter of a bladder in association with said event; and

(c) storing a correspondence between said volume and said physical parameter in said detector device.

65. A method according to claim 64, wherein measuring comprises measuring a distension of said bladder using a frequency sweeping method.

66. A method according to claim 64, wherein said parameter comprises a volume of urine.

67. A method according to claim 66, wherein said volume is measured using a sensor and automatically provided to said detector device.

68. A method according to claim 64, wherein said parameter comprises a bladder wall thickness.

69. A method of measuring bladder distension, comprising:

(a) sending a measurement signal to an off-center bladder to measure a one dimensional geometrical parameter of said bladder; and

(b) estimating a distension of said bladder from said measured parameter.

70. A method of detecting a wall of a bladder, comprising:

(a) detecting a level of acoustic signal ostensibly from urine; and

(b) searching for a signal from a bladder wall to be greater in amplitude than the detected level.

71. A method of estimating a bladder fill level above 70% thereof, comprising:

(a) transmitting an acoustic signal to the bladder;

(b) determining an indication of a distension of said bladder in one dimension; and

(c) determining a fill level of said bladder to be above 70%, from said indication, using at least one personalized calibration value.

72. A method according to claim 71, wherein said acoustic signal comprises a frequency swept scalar signal.

73. A method of selecting device parameters, comprising:

(a) providing a device design for use in a body geometry and having at least one of a selectable acoustic transducer geometry and an operating frequency; and

(b) selecting at least one of said operating frequency and said body geometry such that said body geometry lies within a Fresnel zone of said transducer operating at said frequency.